

Acoustic Measurement of Formant Frequency of Distorted Speech in Adult New Zealanders

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Distorted speech

- ▶ **The neurologic collapse of speech**

 - Dysarthria** caused by distortion of muscles movements

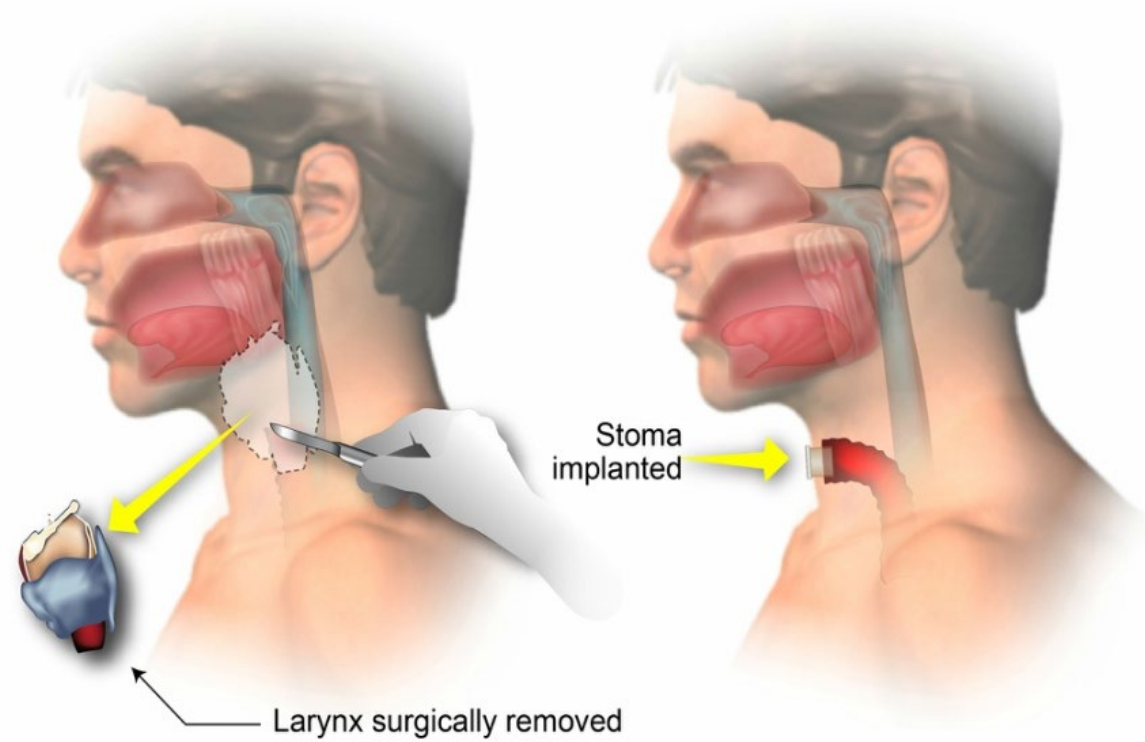
 - Apraxia** caused due to impaired ability to plan

- ▶ **The non-neurologic collapse of speech**

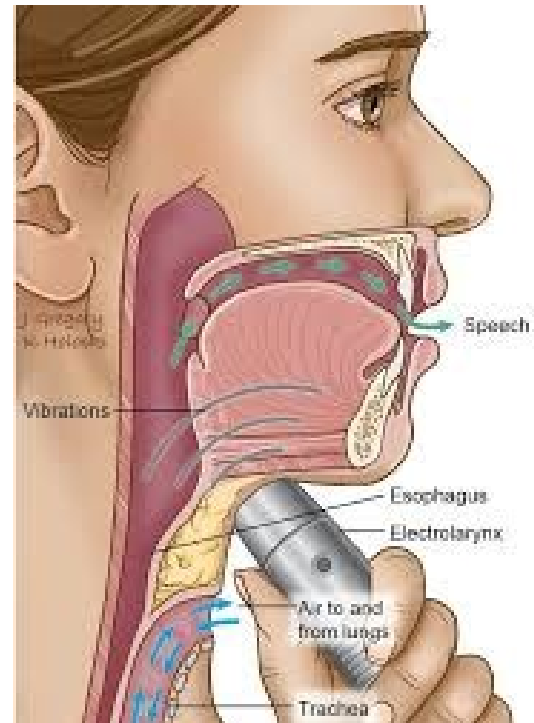
 - Psychogenic speech disorders** (e.g. schizophrenia, depression, hysteria)

 - Musculoskeletal defects** (vocal cords nodules, paralysis and laryngectomy)

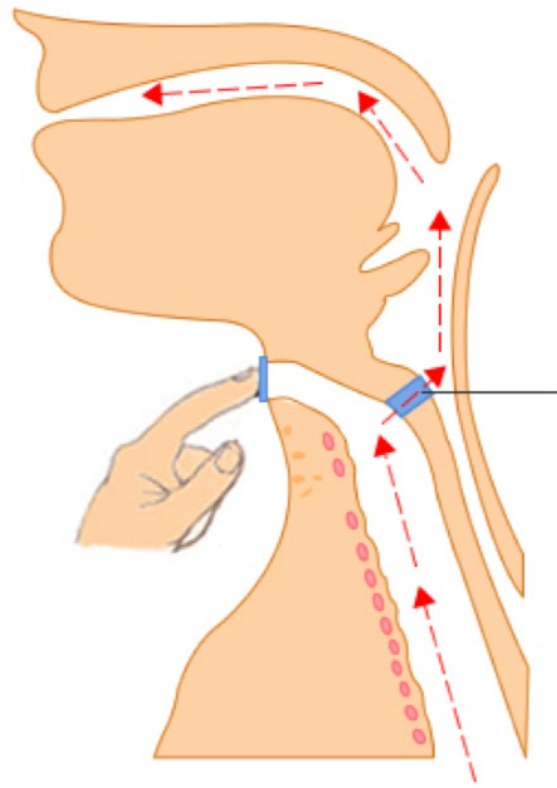
What is laryngectomy?



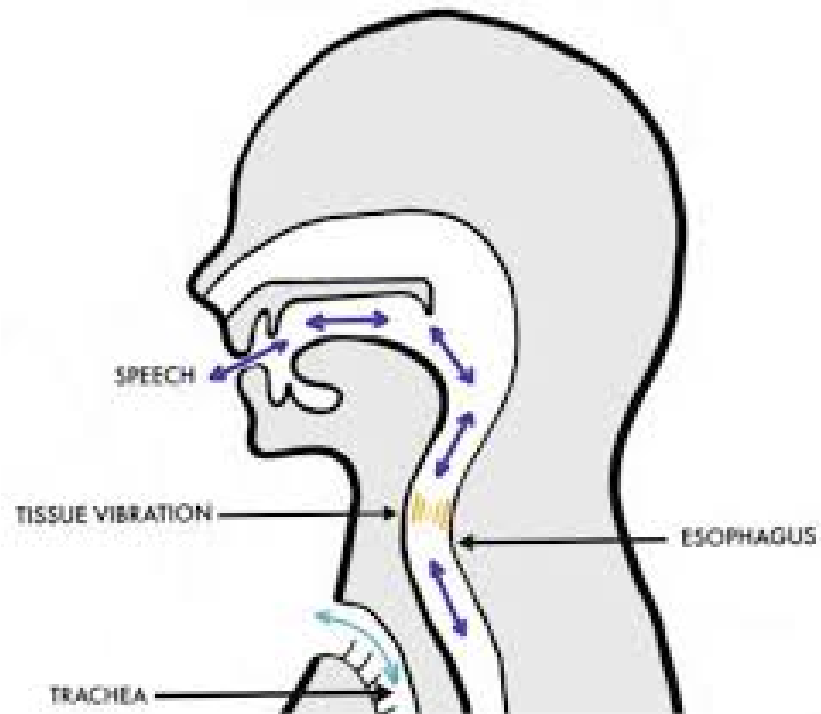
Current rehabilitative methods: Electrolarynx



Current rehabilitative methods TEP(Tracheo-Oesophageal Puncture)



Current rehabilitative methods: Esophageal speech



Computational Methods

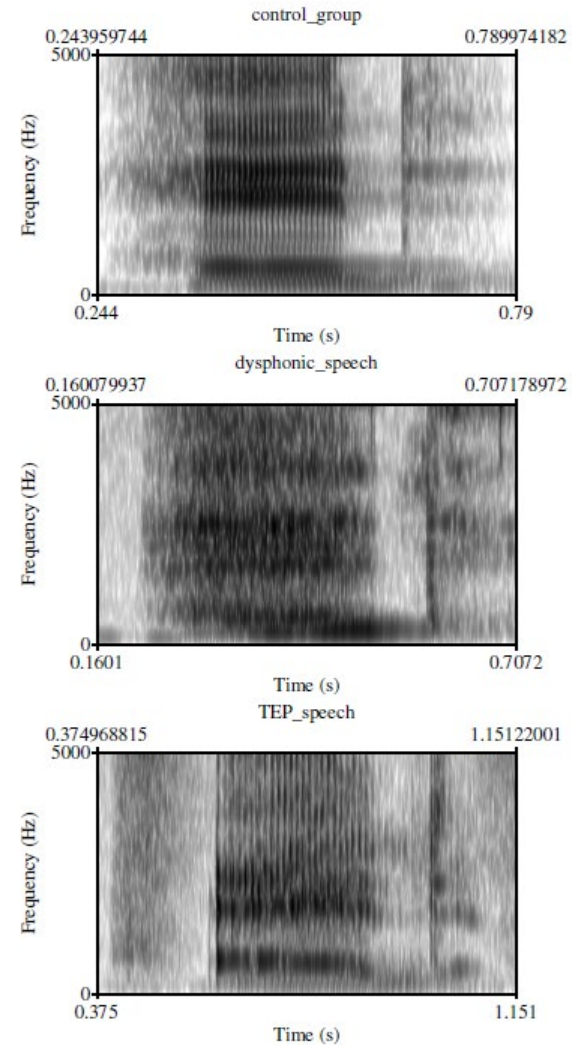
- ▶ Non-invasive alternative solution.
- ▶ Speech processing, speech reconstruction and speech recognition is use for normal speech(e.g. mobile application such as Siri)
- ▶ Acoustic measurements have created the foundational knowledge
- ▶ Acoustic measurements of laryngectomised speech
- ▶ Different type of acoustic measurements

Fundamental frequency measures, Intensity, Perturbation measures, Noise-related measures, Formant frequency measures & Temporal measures

Format

- ▶ The resonant frequencies of the vocal tract are called formants

Figure: Spectrograms of /had/ utterance in control group (top), dysphonic (middle), and TEP speech (bottom).



Data Collection

- ▶ Laryngectomised
- ▶ Control group



Methodology

- Eight control group
- Eight patients:
 - ▶ Dysphonia
 - ▶ Voice prosthesis (TEP)
- Analysis of the two formant frequencies of vowel articulation in /hVd/ words
- The results of both TEP speech and dysphonic speech are compared to the samples collected from healthy control group.
- Statistical analysis P- value and t-test

The result

Comparison of average formant frequencies in four vowels control group with corresponding P-values

Vowel		Control group	Dysphonic	P-value	Significant
/i/	F1	435	455	0.1468	No
	F2	1842	1785	0.1853	No
/æ/	F1	564	573	0.3204	No
	F2	1909	1763	0.0189	Yes
/a/	F1	776	734	0.0340	Yes
	F2	1329	1325	0.4389	No
/u/	F1	391	405	0.1910	No
	F2	1487	1368	0.0419	Yes

Result

Comparison of average formant frequencies of four vowels; CG and TEP with the corresponding P-value

Vowel		Control group	TEP	P-value	Significant
/i/	F1	435	490	0.00006	Yes
	F2	1842	2269	0.00001	Yes
/æ/	F1	564	833	0.00001	Yes
	F2	1909	1899	0.42724	No
/a/	F1	776	840	0.01985	Yes
	F2	1329	1475	0.00001	Yes
/u/	F1	391	494	0.00001	Yes
	F2	1487	1508	0.3936	No

Discussion

An independent samples t-test was performed on the first and second formants of four main vowels for both groups comparing with the control group separately. The results showed similar formant frequencies between dysphonic and normal speech while the differences were significant between TEP and normal speech.

Q&A